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ASD Symptoms in Individuals: A Comparison of Treatments

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Abstract

Background: Research, as described in the different articles chosen for comparison, indicates that individuals with autism spectrum disorder (ASD) commonly experience difficulties in displaying good memory, proper social communication, and doing physical activities.

Purpose: To determine and compare which treatment type—physical therapy, psychotherapy, or pharmacotherapy—is commonly used and effective for treating what specific symptom of ASD (primarily in children and adolescent diagnosed subjects that are experiencing difficulties).

Methods: 10 peer-reviewed articles published between 2015 and 2020 from different Databases, including CINAHL Complete, MEDLINE (ProQuest), and EMBASE.com, were retrieved.

Results: Thorough examination of the 10 selected studies indicate that all 4 chosen physical therapy articles mentioned procedures that helped improved motor and balance control skills, compared to only 2 of 3 pharmacotherapy studies being successful in treating irritability and 2 of the 3 psychotherapy studies recommended in treating anxiety associated with ASD.

Conclusion: Further research is needed to come to a more decisive conclusion, but the present review of the articles supports the claim that for ASD, pharmacotherapy commonly is used to treat irritability symptoms, physical therapy is commonly used to treat motor skills and balance control, and psychotherapy is commonly used to treat anxiety that results from ASD.

Keywords: ASD, RCT, metformin, aripiprazole, omega fatty acids, psychotherapy, cognitive behavioral therapy, personal construct theory, tai chi chuan, scalp acupuncture

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Introduction

Autism Spectrum Disorder (ASD) is a hypernym of a number of neurological conditions (Asperger syndrome, childhood disintegrative disorder, autism, and pervasive development disorder - not otherwise specified) characterized by an impairment of the central nervous system's (CNS) functions and delay in many areas of development according to the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM). An estimated 1 in every 160 children suffer from ASD around the world, and the numbers have been increasing according to the World Health Organization (WHO) (Yau et al., 2018). The condition reigns in America, affecting 1 in 59 children of eight years of age, with prevalence in boys, but more severity in girls (Sarabzadeh et al., 2019). The male to female ratio is debated a lot, however. Officially recognized symptoms of ASD include repetitive patterns of behavior as well as the inability to properly communicate and socially interact (Ichikawa et al., 2017).

The affected may show signs of aggressiveness, irritability, sudden mood changes, and self-injurious behavior, which can affect their social and educational development (Ichikawa et al., 2017). Depression, anxiety, and anhedonia are symptoms often observed in adolescents with ASD caused most likely by peer victimization (Wood et al., 2015). Furthermore, these symptoms have some functional impact as well. Clinical anxiety, for example, is related to great impairments in social response and skill, which prevents one from being able to properly develop good relationships (Wood et al., 2015). The inability to form good relationships can then cause these individuals to experience loneliness and psychological distress. Apart from the aforementioned diagnostic deficits of ASD, there is evidence that children with ASD have motor impairments as well, which include: impaired postural control, poor balance, dyspraxia, cloddish

gait, incoordination, clumsiness, and below par dexterity skills. These motor deficits can be identified in children as early as in their first year of birth, and these deficits worsen in magnitude as the child grows (Kaur & Bhat, 2019). Motor impairments usually lead to a decrease in physical activity, which in turn can result in high obesity rates for those with ASD (Sarabzadeh et al., 2019).

Currently, no treatments can target the core problems associated with ASD. This is why there is no cure for this condition. However, there are medications that commonly help alleviate related comorbid symptoms, such as irritability, which are atypical antipsychotics like risperidone and aripiprazole that are approved by the Food and Drug Administration (FDA) for treating irritability symptoms related to ASD (Ichikawa et al., 2017). Psychotherapies (personal construct theories, cognitive behavioral therapy, and family-focused therapy) and complementary and alternative medicine (CAM) treatments like of physical therapies (yoga, acupuncture, and tai chi chuan) are used in treating ASD symptoms like motor impairments and mental health problems as well.

The ASD condition makes life very difficult for the affected when they have so many physical, social, behavioral, and even cognitive deficits and puts a burden on their families as they require assistance from them in performing daily living activities like dressing, bathing, and engaging in sports. Which is why researchers must determine what is the best course of treatment to help alleviate specific symptoms of ASD and utilize that treatment method more often depending on what the affected is suffering from. This article is a literary analysis of several different therapies that treat ASD symptoms and will evaluate each treatment's effectiveness to determine which therapy type—physical therapy, psychotherapy, or pharmacotherapy—is commonly used, effective, and recommended to treat what specific symptoms of ASD.

Methods

A total of 10 articles from 4 Databases, including CINAHL Complete, MEDLINE (ProQuest), and EMBASE.com were retrieved. These articles were published between the years 2015 and 2020 and were obtained by accessing nova southeastern university's (NSU) library online. Ulrich's web was used to confirm that the articles chosen were all peer reviewed. These 10 articles were thoroughly analyzed and used to generate the points made in this literature review.

Literature Review

In the randomized, placebo-controlled, double-blinded trial study "Effects of Metformin on Spatial and Verbal Memory in Children with ASD and Overweight Associated with Atypical Antipsychotic Use" (Aman et al., 2018) the purpose was to determine if metformin can improve spatial/verbal memory in children with ASD (autism spectrum disorder) and overweightness that comes with atypical antipsychotic use (Aman et al., 2018). They studied metformin's effect on spatial and verbal memory in 51 people (aged 6-17) with ASD who were already taking atypical antipsychotic medications, were overweight (most likely because of the medications), and were part of a metformin for weight management trial. The study contained 2 different phases. Phase 1 was a randomized placebo-controlled trial that was double-blinded. It was a group to group comparison trial of metformin vs placebo-given individuals (they received 500-850mg of their medication twice a day). Phase 2 had all the participants take metformin for another 16 weeks (Aman et al., 2018). One limitation of the study was the small sample size. Also, 84 percent of the participants of the study were taking more than one psychotropic medication, leading to the possibility that these drugs may have interfered with the effects of metformin on these subjects. Lastly, metformin was only test for its effect on spatial and verbal memory, but it may have had

a cognitive effect as well, possibly on attention or executive function (Aman et al., 2018). In the end, the results indicated that there is no apparent effect of metformin on spatial and verbal memory of these individuals.

The article "Aripiprazole in the Treatment of Irritability in Children and Adolescents with Autism Spectrum Disorder in Japan: A Randomized, Double-blind, Placebo-controlled Study" (Ichikawa et al., 2017) is also another randomized, placebo-controlled, double-blinded study with the aim of evaluating the efficacy and safety of aripiprazole in treating irritability symptoms in individuals with ASD (mainly children and adolescents for this study). A total of 92 participants were randomized into two groups: 45 into the placebo group and 47 into the treatment group. Furthermore, for 8 weeks every day, patients received 1-15 mg of either aripiprazole or placebo. Explicitly stated limitation of the study was that it was too short. The results indicated that Aripiprazole was effective and safe for use compared to the placebo group in treating irritability symptoms in Japanese children and adolescents with ASD, as seen in **Figure 1**.

In another randomized, placebo-controlled, double-blinded pilot trial study "ω-3 and ω-6 Fatty Acid Supplementation May Reduce Autism Symptoms Based on Parent Report in Preterm Toddlers" (Keim et al., 2018) the study investigated the effects that combined supplementation of omega-3-6-9 junior, DHA, GLA, and EPA has on ASD symptoms and similar behaviors reported by the parents (Keim et al., 2018). This study was a 90 day fully blinded, randomized, placebo-controlled trial. The participants were 31 children between the age of 18–38 months who were born preterm (at around 29 or even less weeks of gestation). The experimental group was assigned to daily treatment of Omega-3-6-9 Junior including 338 mg of EPA, 225 mg of DHA, and 83 mg of GLA. The placebo treatment group received canola oil. Mixed-effects regression

analyses was used to investigate the effects on ASD symptoms and similar behaviors reported by parents. One limitation of the study was that they had to rely on the parents report for outcomes of interest rather than direct assessment. The other one was that the effects observed in this study was limited to one outcome measure (Keim et al., 2018). The results indicated that Omega-3-6-9 supplementation does work to reduce core ASD symptoms (irritability and hyperactivity) in young children overall, as depicted in **Figure 2**.

In the randomized control trial study "The effect of six weeks of Tai Chi Chuan training on the motor skills of children with Autism Spectrum Disorder" (Sarabzadeh et al., 2019) the aim was to determine the effect of what a 6-week Tai Chi Chuan training has on the disabilities (motor skills specifically) caused by ASD in children, and they hypothesized it to be an effective therapeutic method to improve the challenges that children with ASD face. The author of the study selects 18 children between ages 6-12 with autism as participants from a pool of 58, using a specific criterion. Of these 18 children, 9 were allotted to the experimental group that received the training, and 9 to the control group that received no training throughout the study at all. The experimental group had to take part in a 6-week training program which consisted of 60-minute Tai Chi Chuan workouts for three days per week (Sarabzadeh et al., 2019). Each training session consisted a 10-min warm-up, 40-min of practicing the 6 basic Tai Chi Chuan forms, and a 10-min cool-down. The motor skill performances of the subjects of the study were assessed by the "M-ABC-2" test before and after the training program. The results indicated that there was an improvement in ball skills and balance, but no change in manual dexterity (serving as its limitation), as shown in **Figure 3**. Overall, this training method can improve balance and motion coordination in children with ASD.

In the pretest-posttest design study “Creative Yoga Intervention Improves Motor and Imitation Skills of Children With Autism Spectrum Disorder” (Kaur & Bhat, 2019) the purpose was to evaluate the effectiveness of a physical therapeutic intervention using an 8-week creative yoga design on the motor and imitation skills of children with ASD. The study selected 24 children with ASD between ages 5 and 13 years old and had them undergo 8 weeks of supervised yoga (Kaur & Bhat, 2019). Children were tested before and after the supervised yoga intervention using a standard motor measure. The imitation skills of children were assessed using known training-specific actions of yoga and building (Kaur & Bhat, 2019). Children in the yoga group showed improved gross motor performance and displayed fewer imitation/praxis errors when copying training-specific yoga poses unlike the children in the academic group, who improved their fine motor performance and displayed few imitation errors when finishing the training-specific building actions (Kaur & Bhat, 2019). Overall, the results indicated that yoga can make great contributions as a therapeutic intervention for enhancing the motor and imitation skills of children with ASD.

In the retrospective study “The therapeutic effect of scalp acupuncture on natal autism and regressive autism” (Yau et al., 2018) the aim is to understand how scalp acupuncture affects the symptoms of children with ASD. The study went about recruiting 68 patients diagnosed with ASD that were between the ages of 2-11 years old. The subjects underwent a total of 30 scalp acupuncture therapy sessions, and their performance on various aspects was evaluated before and after the treatment (Yau et al., 2018). They also took into consideration what kind of influence age and onset pattern would have on the therapeutic effect of the scalp acupuncture. The results indicated that the scalp acupuncture was 97 percent effective in treating the symptoms of ASD (especially verbal communication), lacking only in the ability to improve noise sensitivity, as can

be seen in **Figure 4**. Also, the therapeutic effectiveness seems to decrease with increasing age (Yau et al., 2018). One limitation of the study was the less than adequate sample size, and the fact that they did not have fMRI data to determine the change in brain function throughout the treatment. In summary, Scalp acupuncture is a great therapeutic intervention that helps alleviate ASD symptoms and it is more effective the earlier it is introduced to the patient (in other words, younger patients with ASD receive the most benefits from this).

In another pretest-posttest design study "Effect of Motorized Elephant-Assisted Therapy Program on Balance Control of Children with Autism Spectrum Disorder" (Nuntanee & Daranee, 2019). The purpose was to create and examine the effect of the motorized elephant-assisted therapy program (METP) on balance control in children and adolescents with ASD. The study went about selecting Twenty participants diagnosed with ASD, that were between the ages of 8 to 19 years old, from occupational therapy clinics in Chiang Mai city and divided them into one control and one experimental group (Nuntanee & Daranee, 2019). Subjects' control on their balance was examined by measuring the postural sways in their bipedal stances using a Swaymeter under four different conditions (Nuntanee & Daranee, 2019). Pretests were given a week before participation in the METP, and then posttests were given one week after completion of the METP. Each participant took part in the METP for a duration of four weeks (twice a week, 1.5 hours each session). In every session, two subjects would be assigned to work with two motorized elephants in four different activities: washing the elephant, climbing up and down the elephant, riding the elephant, and playing a game while riding the elephant (Nuntanee & Daranee, 2019). As it is supposed to be, there were not much differences in the balance control of the control and experimental groups at the time of the pretest. At posttest, however, the postural sway of the experimental group was different from that of the control group in the floor-

eyes open and floor-eyes closed conditions. Their postural sway being less anteroposteriorly (meaning both front and back) indicated that the experimental group had shown improvement in balance control (Nuntanee & Daranee, 2019). Limitations included limited generalization to other groups of children with ASD as well as limited applicability due to culture and cost (Nuntanee & Daranee, 2019). Overall, the experimental group displayed a significant improvement in balance control compared to the control group, and it can be deduced that METP could be an alternative treatment method to facilitate better balance control in individuals with ASD.

In the randomized control trial study "Cognitive Behavioral Therapy for Early Adolescents With Autism Spectrum Disorders and Clinical Anxiety: A Randomized, Controlled Trial" (Wood et al., 2015) the motive is to evaluate the efficacy of cognitive behavioral therapy (CBT) on early adolescents with ASD. The subjects of the study were 33 adolescents between the ages of 11-15 years old and they were randomly assigned to either 16 sessions of the treatment or an identical waitlist condition (Wood et al., 2015). The CBT treatment group outperformed the waitlist condition in both anxiety severity according to PARS scale (see **Figure 5**) and positive response posttreatment according to CGI-improvement scale. CBT was especially effective in treating autism severity, according to parents. Limitation of the study included an inadequate sample size. Overall, the findings suggest that CBT can treat anxiety and target core ASD symptoms for some youth and is overall clinically beneficial treatment.

In the randomized control trial pilot study "A Pilot Study of Family-Based Exposure-Focused Treatment for Youth with Autism Spectrum Disorder and Anxiety" (Storch et al., 2020) the purpose was to examine the efficacy of family-based exposure-focused treatment (FET) for youth with ASD experiencing anxiety due to their condition by examining the rates of symptom

reduction themselves and through parent-reports on ASD symptom severity following FET. The study went about doing this by dividing their 32 ASD diagnosed subjects (aged 6-17 years old) into the FET treatment group (n=14) and treatment as usual (TAU) control group (n=18). The FET group had 12 weekly therapy sessions that lasted 45-55 minute long, while the TAU control group engaged in psychotherapy/pharmacotherapy as often as their families desired (Storch et al., 2020). The results indicated that, the subjects of the treatment group had improvements in their anxiety (see **Figure 6**), even after a 2-month follow-up. Limitations of this study include a small sample size, uncertainty of how effective it is when comparing youth vs elderly, and that the participants did not have severe ASD like most, meaning that children with more severe symptoms may require a multi-step intense intervention. In summary, the study supports the use of FET as a brief intervention for youth with ASD experiencing anxiety, however, FET did not really reduce core ASD symptoms. Nonetheless, the subjects with ASD of this study benefited from FET.

In the qualitative research study "Using personal construct methodology to explore relationships with adolescents with Autism Spectrum Disorder" (Murphy, Burns, & Kilbey, 2017) the purpose was to provide an analysis on how the concept of "relationships" are described by adolescents with ASD in order to determine what can be deduced about the development of successful interpersonal relationships for these individuals, and to determine just how useful are the personal construct theory (PCT) techniques in exploring relationship formation in the group of adolescents recruited for this study (Murphy et al., 2017). The study went about utilizing an exploratory qualitative design, using semi-structured interviews that incorporated two PCT techniques (dyadic construct elicitation and laddering) in order to answer the research questions of the study. It was found that the participants of this study viewed relationships with family and

friends as supportive and important comrades in the development of social skills, needed emotional support as they had difficulties interacting with peer, viewed friendships as desirable, valued individuality and uniqueness coming from being different, valued trust and respect in relationships, valued intelligence as a prospect, valued interpersonal skills as a relationship establisher, and acknowledged that successful relationships revolve around humor and shared interests. One limitation of the study was that of the two PCT techniques, the laddering approach was not as successful as the dyadic construct elicitation approach and needed further testing because it was not always clear how one construct linked with another and how one construct was superordinate over another (Murphy et al., 2019). In summary, it was found that personal construct theory (PCT) is an important therapeutic intervention for adolescents with ASD. Furthermore, PCT can make great contributions not only in related research but also in medical interventions.

Discussion

All the aforementioned therapies are beneficial for treating some symptom of ASD. However, treatments still vary in their success rates, and therefore some treatments do end up being more practical than others. The treatments that seem ineffective may not be so because there is a problem with the treatment itself. The fault may lie in its use; maybe it's not meant to be used by its sole self. Some therapies are not helpful by themselves, but work better to reduce ASD symptom severity when used in adjunct with other treatments, like the psychotherapy FET for example, considering that it is only meant to be a brief intervention that can reduce anxiety related to low attributed ASD (that is not to say that all psychotherapies are supposed to be used in adjunct). Be that as it may, the aim of this review is to determine which therapy type is used more commonly to treat what symptom of ASD.

Of the reviewed pharmacotherapies, aripiprazole was effective in treating irritability symptoms associated with ASD. The same was true for ω-3 and ω-6 supplementation, which treated irritability in addition to hyperactivity. Metformin, on the other hand, did not have the intended effect of improving spatial and verbal memory of the children with ASD, or any effect for that matter. Results were different, however, for the physical therapies reviewed. Yoga improved motor skills, METP improved balance, and tai chi chuan improved both motor and balance control skills of the children with ASD. Scalp acupuncture was slightly different as it improved the verbal skills of the affected participants. Lastly, the CBT and FET psychotherapies both displayed their ability to treat anxiety in ASD patients. The PCT techniques as a whole not only did the same, but also improved the social skills of the affected adolescents and instilled in them more confidence whether it's about them and their condition or to pursue a relationship. However, like previously mentioned, FET is not a long-term intervention and is only recommended to be effective when used briefly and in adjunct with other treatments simultaneously.

In the end, the three chosen articles of both the psychotherapies and pharmacotherapies were not in complete favor of supporting their own procedures for ASD treatment use, unlike the physical therapy articles. Which indicates to us that improving poor motor skills and balance in children with ASD seems to be much easier than treating the more underlying problems associated with ASD, like anxiety and irritability. The limitation common across all studies was the inadequate sample size and the bias was that they had more male subjects than female subjects participating in the experiment. This could not be helped because ASD is more prevalent in males and it is therefore hard to find an adequate number of females diagnosed with ASD for the purposes of their research.

Summary

Pharmacotherapy, physical therapy, and psychotherapy are all treatments that are commonly used to alleviate ASD symptoms and are helpful. The current review has evaluated and re-confirmed that pharmacotherapy is a commonly used and recommended treatment for irritability resulting from ASD, physical therapy is commonly utilized and recommended to improve poor motor skills and balance control associated with ASD, and psychotherapy is commonly used and recommended to treat anxiety resulting from ASD. A unique finding was that scalp acupuncture, a physical therapeutic technique, was effective in improving verbal communication in children with ASD, completely unlike the other physical therapies that commonly helped to improve motor skills and balance control. In the end, however, it is not as surprising because acupuncture does not involve any physical activity unlike the other physical interventions, but one would still expect to see some correlation among the results of those physical studies. The bias of this study was that there were 4 physical therapy articles evaluated compared to only 3 that were concerned with pharmacotherapy, and 3 more that were concerned with psychotherapy. Furthermore, the limitation of this review was that there were only 10 articles evaluated. To provide more substance for the purpose of the research, we would need to do a in-depth review of more than just 10 peer-reviewed studies. With these limitations in mind, perhaps the outcome of this review would have been different. Furthermore, to make more decisive conclusions, further research is needed.

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Appendix

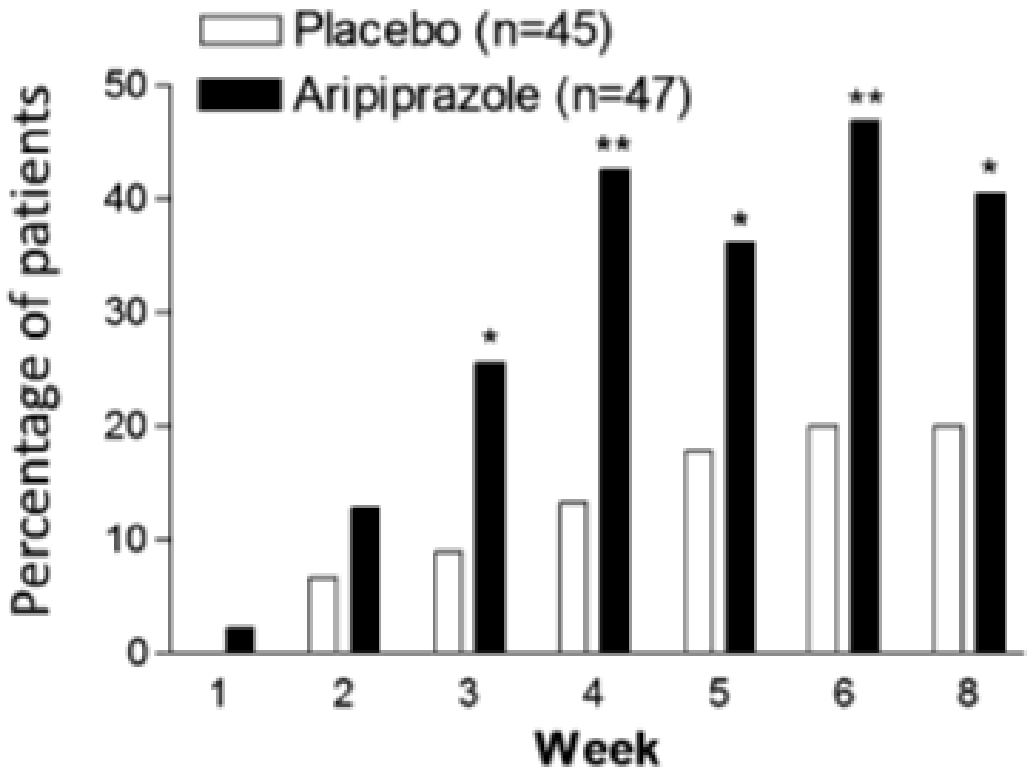

Fig. 5 Treatment response rate by week (LOCF; efficacy sample). The treatment response was defined as ≥25% reduction from baseline in the Aberrant Behavior Checklist Japanese Version Irritability subscale score and a Clinical Global Impressions-Improvement score of 1 or 2. *LOCF* last observation carried forward. *P<0.05; **P<0.01 versus placebo

Figure 1: Treatment responses of Aripiprazole compared to placebo

TABLE 2 Change from baseline to trial completion for primary outcome measures in 18–38 month old children with ASD symptoms born preterm (≤29 wk gestation), randomly assigned to 90 d of Omega-3-6-9 Junior (treatment; Nordic Naturals, Inc.) or canola oil (placebo): Preemie Tots Trial, 2012–2015[1]

	Baseline score		Endpoint score		Change				
Parent ratings of behavior and development	Treatment	Placebo	Treatment	Placebo	Treatment	Placebo	Difference in change[2]	Effect size[3]	*P*
PDDST-II Stage 2	6.7 ± 2.2	5.3 ± 2.7	5.8 ± 2.5	5.4 ± 2.5	−1.0 ± 2.6	−0.2 ± 1.9	−0.4 (−2.1, 1.4)	−0.16	0.67
BITSEA[4]									
Competence	12.7 ± 4.4	13.0 ± 3.2	15.0 ± 2.4	13.7 ± 2.8	1.9 ± 3.2	0.9 ± 3.6	1.2 (−0.8, 3.2)	0.34	0.22
Problem	17.1 ± 12.8	15.0 ± 7.4	13.3 ± 10.3	12.9 ± 6.8	−3.2 ± 6.1	−3.2 ± 5.0	0.2 (−3.2, 3.5)	0.03	0.92
Dysregulation	5.6 ± 3.9	5.1 ± 2.6	4.7 ± 3.8	3.8 ± 1.8	−0.9 ± 2.3	−0.8 ± 2.2	0.1 (−1.4, 1.7)	0.06	0.88
Externalizing	3.4 ± 3.5	3.5 ± 2.8	3.7 ± 3.3	3.5 ± 2.8	0.3 ± 1.3	−0.7 ± 2.3	0.8 (−0.5, 2.1)	0.49	0.23
Internalizing	3.9 ± 3.1	3.6 ± 3.1	3.2 ± 2.5	3.0 ± 2.4	−0.9 ± 2.3	−0.5 ± 2.3	−0.1 (−1.4, 1.2)	−0.04	0.91
ASD	7.0 ± 3.6	6.4 ± 4.1	5.3 ± 2.5	7.6 ± 3.2	−1.5 ± 2.6	0.8 ± 3.8	−2.1 (−4.1, -0.2)	−0.71	0.03
Red flag	6.1 ± 5.3	4.9 ± 2.6	3.5 ± 2.4	4.5 ± 2.6	−2.5 ± 3.8	−1.0 ± 2.8	−1.2 (−2.5, 0.1)	−0.39	0.07
Response to name ("Not true/rarely"),[5] *n*	1	0	1	0	—	—	—	—	—
Response to joint attention ("Not true/rarely"),[6] *n*	1	0	0	1	—	—	—	—	—

[1]Values are means ± SDs, frequencies, or differences in change (95% CIs), unless otherwise indicated; $n = 15$ (treatment) or 16 (placebo). ASD, autism spectrum disorder; BITSEA, Brief Infant Toddler Social and Emotional Assessment; PDDST-II, Pervasive Developmental Disorders Screening Test II, Stage 2.
[2]Difference in change is based on a mixed-effects model analogous to ANCOVA with the use of maximum likelihood to account for missing data. Three children did not participate in the last trial visit, and thus the difference in change values may differ from the raw summary statistics presented for the within-group mean change and SD. No participant characteristics were included as covariates.
[3]Values are Cohen's *d* effect sizes.
[4]Negative values signify improvement, with the exception of BITSEA competence for which positive values indicate improvement.
[5]No children gained or lost this ability during the trial.
[6]One child in the treatment group gained this ability and 1 child in the placebo group lost this ability during the trial.

Figure 2: Reduction in core ASD symptoms after taking Omega-3-6-9 supplementation as indicated by test scores.

Table 2
Pre-test and post-test comparison of motor skills between the groups.

Variables	Groups	Pre-test	Post-test	Mean difference	Dependent T	Sig	Independent T	Sig
manual dexterity	Tai chi	57.03 ± 13.27	56.66 ± 10.92	−0.37	0.31	0.76	0.06	0.95
	Control	55.55 ± 14.24	56.29 ± 14.47	0.74	−1.51	0.16		
ball skills	Tai chi	58.33 ± 9.01	30 ± 7.50	−28.33	11.33	<0.001	−9.24	<0.001
	Control	60 ± 8.29	62.77 ± 7.54	2.77	−1.64	0.13		
balance	Tai chi	60.73 ± 12.66	14.81 ± 6.26	−45.92	10.60	<0.001	−14.37	<0.001
	Control	62.58 ± 10.10	64.81 ± 8.35	2.23	−2.30	0.05		
Total	Tai chi	58.75 ± 6.49	34.30 ± 3.48	−24.45	13.53	<0.001	−9.95	<0.001
	Control	59.30 ± 8.70	61.38 ± 7.38	2.08	−3.53	0.008		

Note: scores are illustrated in percentages (%), and a higher score indicates more motor disorders.

Figure 3: Significant improvement in ball skills and balance after undergoing tai chi chuan training.

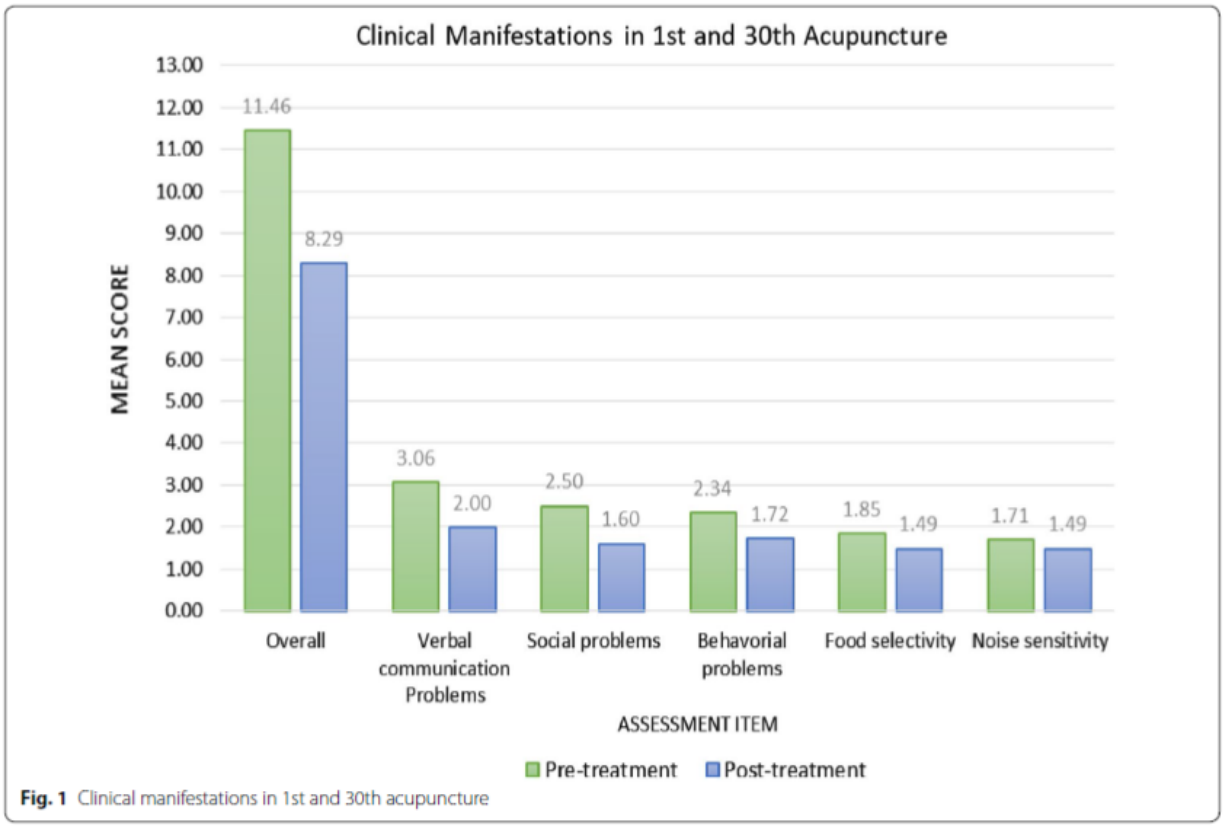

Figure 4: Scalp acupuncture effectiveness pre-treatment vs post-treatment

Table 2
Descriptive Statistics for Outcome Variables for Children in the Immediate Treatment (CBT) and Waitlist (WL) Conditions

Measure	WL (n = 14)			CBT (n = 19)			
	Baseline M (SD)	Post-treatment M (SD)	d_w	Baseline M (SD)	Post-treatment M (SD)	d_w	d_b
PARS	18.29 (2.09)	14.04 (2.64)	1.71	17.16 (2.39)	11.62 (3.26)	1.78	0.74
SRS	113.25 (22.49)	105.75 (11.89)	1.52	108.41 19.08)	82.56(16.34)	6.01	1.17
ADIS-CSR	5.50 (0.65)	4.04 (1.88)	0.36	5.68 (0.89)	3.28 (2.10)	0.64	0.39
MASC-P	62.49 (14.48)	58.44 (9.01)	1.37	60.58 (16.01)	50.21 (12.71)	2.85	0.59
RCADS	24.65 (17.31)	18.31 (14.09)	1.71	28.09 (20.27)	19.58 (14.65)	1.47	0.02

Note. All statistics are based on the same multiple imputation models used for study analyses; d_w = Within-subjects d; d_b = Between-subjects d; Abbreviations: PARS = Pediatric Anxiety Rating Scale; SRS = Social Responsiveness Scale; ADIS-CSR = Anxiety Disorders Interview Schedule Clinical Severity Rating; CBCL = Child Behavior Checklist; RCADS = Revised Child Anxiety and Depression Scale.

Figure 5: CBT treatment compared to waitlist condition

Table 2 Descriptive statistics, inferential statistics, and effect sizes for primary and secondary outcomes at all timepoints

Measure	Baseline		Post-treatment				2-month follow up		
	FET *M* (*SD*)	TAU *M* (*SD*)	FET *M* (*SD*)	TAU *M* (*SD*)	t[b]	*d*[b]	FET *M* (*SD*)	*t*[c]	*d*[c]
IE-rated									
PARS	14.07 (2.34)	16.22 (2.67)	7.79 (5.37)	15.06 (3.21)	3.47**	1.01	3.58 (4.28)	0.93	0.35
ADIS CSR[a]	4.50 (0.52)	5.33 (0.84)	2.05 (1.85)	5.00 (0.77)	3.88**	1.11	0.43 (0.77)	2.28	0.82
CGI-S	3.29 (0.73)	3.67 (0.59)	2.25 (0.87)	3.67 (0.69)	4.45**	1.22	1.42 (0.52)	1.26	0.46
Parent-rated									
CAIS-P									
Total	33.90 (16.89)	29.58 (15.23)	16.49 (14.95)	32.10 (16.11)	3.18**	1.04	12.48 (16.28)	−0.53	−0.20
School	14.01 (6.64)	11.71 (6.58)	4.59 (4.09)	13.29 (6.44)	4.92**	1.71	5.56 (7.83)	−0.71	−0.26
Social	9.98 (7.01)	8.19 (6.80)	5.53 (5.90)	8.58 (6.65)	1.97	0.58	2.77 (3.09)	0.23	0.10
Home	4.79 (3.51)	6.01 (4.56)	2.21 (2.72)	5.72 (3.77)	2.59*	0.81	2.36 (6.04)	−0.62	−0.22
Global	6.36 (1.91)	6.49 (2.53)	3.52 (3.20)	6.00 (2.51)	2.52*	0.75	0.96 (0.98)	1.36	0.49
MASC-P	45.74 (13.13)	50.82 (13.80)	38.59 (15.84)	53.51 (14.82)	1.91	0.54	24.78 (11.41)	1.57	0.65
SRS									
Total	100.07 (24.61)	102.50 (24.21)	84.58 (25.98)	98.56 (24.90)	1.44	0.47	81.21 (26.69)	−0.43	−0.16
Awareness	13.07 (4.14)	11.44 (3.33)	11.22 (3.62)	12.06 (3.78)	1.22	0.39	13.43 (3.92)	−2.64*	−1.03
Cognition	20.14 (4.66)	20.50 (5.84)	16.17 (5.45)	19.06 (5.06)	1.49	0.48	16.22 (6.30)	−0.38	−0.14
Communication	33.57 (8.48)	32.94 (8.29)	29.09 (9.21)	32.67 (8.73)	1.36	0.41	26.39 (8.40)	0.25	0.09
Motivation	16.79 (6.00)	17.72 (6.04)	13.23 (5.27)	15.17 (5.55)	0.86	0.26	12.05 (2.78)	−0.73	−0.27
Mannerisms	16.50 (6.76)	19.89 (6.91)	14.94 (6.92)	19.61 (7.38)	1.41	0.48	13.65 (7.96)	0.05	0.02
CBCL									
Internalizing	13.12 (6.45)	17.74 (6.64)	10.61 (8.20)	20.41 (7.60)	2.55*	0.84	4.88 (4.96)	2.27	0.84
Externalizing	10.00 (8.68)	14.27 (8.62)	5.60 (4.12)	16.99 (12.32)	2.80**	0.79	4.41 (3.31)	1.07	0.43
SDS	22.14 (11.48)	30.00 (11.59)	12.02 (11.96)	26.83 (11.61)	2.62*	0.84	3.34 (4.74)	1.00	0.36

[a]Clinical severity rating associated with principal diagnosis

[b]Post-treatment analyses evaluated the effect of treatment condition while accounting for baseline group differences

[c]Analyses compare 2-month follow-up to post-treatment status for treatment responders

*$p < .05$; **$p < .01$

Figure 6: FET treatment effectiveness in anxiety